Alberta Provincial Achievement Testing

A Guide for Teachers 2010–2011

GRADE 3

Mathematics

Government of Alberta

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Follow these steps for easy access to the Alberta Education website:

Step 1: Type education.alberta.ca
Step 2: Click on the tab labelled *Teachers*
Step 3: Scroll down to *Additional Programs and Services*
Step 4: Click on *Provincial Testing*
Step 5: Scroll down to *Achievement Tests* and click on it

On the *Achievement Tests* web page, there is a specific link to *Subject Bulletins* that provide students and teachers with information about the achievement tests scheduled for the current school year. Please share the contents of the *Grade 3 Mathematics Subject Bulletin* with your students and their parents.

This document was written primarily for:

Students	
Teachers	✓ Grade 3 Mathematics
Administrators	✓
Parents	
General Audience	
Others	

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Description of the Grade 3 Mathematics Assessment
(2007 Program of Studies)

General Description

The Grade 3 Mathematics Provincial Achievement Test (PAT), based on the 2007 program of studies, consists of one booklet that contains 40 multiple-choice questions. Each question is worth one mark. The entire test is developed to be completed in 60 minutes. Students may take an additional 30 minutes to complete the test. Children may be given a short break during the test, at a time deemed suitable by the classroom teacher.

Students record the answers to all of the questions directly in their test booklets.

If a word that warrants a definition is used on a test, then it will be defined on the page on which it appears.

NOTE: If a student is having difficulty reading a word or phrase that is NOT a mathematical term, then the teacher may read the word or phrase to the student and explain its meaning.

Multiple-Choice Questions

Teachers who are experienced at the Grade 3 level develop the questions that are used on the PAT. The questions are based on the outcomes as well as the intent of the mathematics program as described in the *Program of Studies*. Each question on the test:

- reflects the content from one or more of the strands: Number, Patterns and Relations, Shape and Space, Statistics and Probability
- addresses one or more of the outcomes in the *Program of Studies*
- has a specified level of difficulty—from relatively easy to challenging
- is classified as low, moderate, or high in complexity*

Classification of Multiple-Choice Questions

Low-Complexity Multiple-Choice Questions

Low-complexity questions typically require students to recall and/or recognize basic mathematical concepts and procedures. Students are not expected to come up with original methods for finding a particular solution. A low-complexity mathematical question may require a student to:

- recall or recognize a fact, term, or definition
- identify an example of a concept
- perform a specified procedure
  (eg. adding, subtracting, multiplying, or dividing)
- determine an unknown number in an equation or number expression
- solve a one-step or simple two-step word problem
- draw or measure a simple 2-D shape or 3-D object
- retrieve information from a graph, table, or figure

Moderate-Complexity Multiple-Choice Questions

Moderate-complexity questions typically involve more flexibility of thinking than those in the Low-complexity category. They require a response that goes beyond the habitual and may involve more than a single step. The student is expected to decide what to do, to use reasoning and problem-solving strategies, and to bring together their skills and knowledge in order to find a solution. A moderate-complexity mathematical question may require a student to:

- solve a word problem requiring multiple steps
- compare patterns, data, or equations
- provide justification for a solution process
- interpret a concrete, pictorial, or symbolic representation
- retrieve information from a graph and use it when solving a multi-step problem
- formulate a generalization about one or more objects or patterns

High-Complexity Multiple-Choice Questions

High-complexity questions typically require students to engage in more abstract reasoning, planning, analysis, judgment, and creative thought. A high-complexity mathematical question may require a student to:

- perform a procedure that has multiple steps and multiple decision points
- analyze similarities and differences between procedures and concepts
- formulate an original problem
- solve a problem in more than one way
- explain and justifying a solution to a problem
- describe, compare, and contrast solution processes
- provide a mathematical justification

Note: The multiple-choice questions on the Grade 3 Mathematics Achievement Test will mainly be questions that are low and moderate in complexity. There will typically be three to five questions on the test that are high in complexity.

*Adapted from Norman L. Webb, Wisconsin Center for Educational Research, "Depth-of-Knowledge for Four Content Areas," March 28, 2002.

Blueprint for the Grade 3 Mathematics Achievement Test
(2007 Program of Studies)

General Outcomes	Multiple Choice (MC) Questions	Proportion of MC Questions per Strand
Number Develop and demonstrate number sense for whole numbers 0 to 1000 and understand fractions as part of a whole. Develop and demonstrate personal strategies when applying arithmetic operations (addition, subtraction, multiplication or division) on whole numbers to create and solve problems. Justify the personal strategies used to solve problems.	18	**45%**
Patterns and Relations Investigate, identify, and communicate rules for numerical and non-numerical patterns, in order to describe the world and to solve problems. Represent, solve, and communicate an addition or subtraction equation with one unknown number.	8	**20%**
Shape and Space Estimate, measure, and compare, using personal referents and standard units of measurement to solve problems. Describe, classify, construct, and relate 3-D objects and 2-D shapes.	10	**25%**
Statistics and Probability Collect, organize, and interpret data in a variety of ways to solve problems. Construct, label, and interpret bar graphs to solve problems.	4	**10%**
Number of Questions	**40**	**40**
Percent of Test	**100%**	**100%**

Conceptual Framework for K-9 Mathematics

"Mathematics education must prepare students to use mathematics confidently to solve problems."
(p. 4, *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*)

Mathematical Processes

There are seven interrelated mathematical processes, described in the front matter of the program of studies, which are intended to permeate the teaching and learning of mathematics. These mathematical processes are:

- Communication [C]
- Connections [CN]
- Mental Mathematics and Estimation [ME]
- Problem Solving [PS]
- Reasoning [R]
- Technology [T]
- Visualization [V]

Detailed explanations of each of these processes are located on pages 6-9 of *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*. Students are expected to understand and use these processes when solving mathematical problems. When teachers who are selected to be item writers develop questions for potential use on a PAT, they also consider the processes that students will need to use in order to find a solution.

Nature of Mathematics

Because mathematics is one way of trying to understand, interpret, and describe our world, students need to be aware of a number of components that define the nature of mathematics. These components are woven throughout the program of studies and are described on pages 10-12 of *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*.
The components are:

- Change
- Constancy
- Number Sense
- Patterns
- Relationships
- Spatial Sense
- Uncertainty

Instructional Focus

The PAT is designed to reflect the instructional focus that is described in the program of studies (See p. 15, *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*). Because the four strands are not intended to be discrete units of instruction, the outcomes from across the strands should be integrated in order to create meaningful mathematical experiences. Students must consistently make connections between concepts both within and across the strands. In order to reflect this instructional focus, students will need to apply their understanding of the concepts from several different outcomes and/or strands in order to solve many of the problems on the PAT.

Use of Manipulatives

Mathematical concepts "should be introduced using manipulatives and be developed concretely, pictorially and symbolically" (p. 15, *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*). Students are encouraged but not required to use the following materials when writing the Provincial Achievement Test (PAT):

APPROVED MANIPULATIVES FOR THE GRADE 3 PAT

Any of the following items that assist students in the problem-solving process are acceptable for use during the test. Manipulative items may include:

attribute blocks
base-ten blocks
centimetre ruler
clocks
coins
counters
dice/number cubes
dominoes
elastic bands
fraction blocks
geoboards
number line (with or without numbers)
one hundred chart (with or without numbers)
pattern blocks
playing/number cards
snap-cubes
sorting mats
string
3-D shapes
tracing paper

NOTE: There are many other types of manipulative materials that students may choose to use. If you have any questions or concerns about manipulative materials, please contact the Grade Three Examination Manager (Deanna.Wiens@gov.ab.ca).

Items Not Approved for Use During the Grade 3 PAT

calculators
multiplication charts or grids
addition charts or grids

Display of Mathematical Materials During the Grade 3 PAT

Any materials which explain, define or describe mathematical concepts and/or problem-solving processes should be removed or covered during the writing of the PAT.

Mathematical Terminology

Communication is one of the seven key mathematical processes. The program of studies states that "Students …need to communicate their learning using mathematical terminology" (p. 6, *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*). By knowing and understanding these terms, students will be able to more effectively communicate their mathematical understanding.

The following vocabulary words are located in the program of studies and the achievement indicators from Kindergarten through Grade 3. **Words that are introduced at the grade three level will be followed by an asterisk (*).**

These lists also represent the mathematical vocabulary that teachers use when they develop questions for the Provincial Achievement Test. Unless students have received approval for an accommodation, they are expected to independently read and understand the mathematical vocabulary listed below.

Number Strand – Key Vocabulary

addition
addition facts
alike
array*
as many as
ascending
backward
counting on
denominator*
descending
difference
digit
division*
doubles
equal groups
equal parts*
equal sharing*
even
expression
fact
fewer
fewer than
forward
fraction*
greatest
groups
least
less than
mental mathematics
more
more than
multiplication*
non-shaded*
number
numerator*
number sentence
odd
order
ordinal numbers
part of a whole*
personal strategy
place holder*
place value
position
problem solving
quantity
referent
region*
related
repeated addition*
repeated subtraction*
represent
set
sequence
shaded*
skip count
solution
statement
starting point
strategy
subtraction
subtraction facts
sum
symbol
thousand*
value
whole number*
zero

Patterns and Relations – Key Vocabulary

attribute
balance
decreasing pattern*
diagonal*
equal (=)
equation
horizontal
imbalance
increasing pattern
inequality (≠)
pattern
pattern rule
repeating pattern
representation
separating*
sorting rule
unknown number*
vertical
Venn diagram

Shape and Space – Key Vocabulary

April
August
accurate
calendar
centimetre (cm)*
circle
common
cone
cube
cylinder
days
December
edge*
equivalent*
face*
February
Friday
gram (g)*
heavier
height
hexagon*
hours (h)*
January
June
July
kilogram (kg)*
length
lighter
March
mass
May
metre (m)*
minutes (min)*
Monday
month
November
object
octagon*
October
overlapping
passage of time*
pentagon*
perimeter*
polygon*
prism*
pyramid
quadrilateral*
rectangle
Saturday
seconds (s)*
September
shape
skeleton*
sphere
square
Sunday
3-D objects
Thursday
triangle
Tuesday
2-D shapes
unit
vertices (vertex)
Wednesday
week
weigh
width
year

Statistics and Probability – Key Vocabulary

axis (axes)*
bar graph*
chart
check marks
data
graph
label*
line plot*
lists
pictograph
tally marks*
title*

Mathematical Processes – Key Vocabulary

apply
calculate
classify*
collect
combine*
compare
conclusion
connect
construct
create
describe
demonstrate
determine
display
draw
estimate
estimation
explain
extend
gather
identify
illustrate
interpret
justify
locate*
match
measure
model
order
organize
predict
process
reason
read
record
relate
repeat
represent
select
show
solve
sort
write

General Mathematical Terms

base-ten materials
counters
column
diagram
dime
errors
geoboard
grid paper
hundred chart
loonie
manipulative
metre stick
money
nickel
number line
object
pattern blocks
penny
pictures
quarter
row
ruler
scale
story problem

Frequently Asked Questions

1. How much time do students have to complete the PAT?

Students have 60 minutes to complete the test. They may take up to 30 extra minutes to finish the test if they need more time.

Students with special accommodations may have more time if these accommodations have been approved.

2. What materials do I need to take down or cover during the test?

Any materials which explain, define or describe mathematical concepts and/or problem-solving processes should be removed or covered during the PAT.

Unless special accommodations have been approved, students should NOT have access to calculators, multiplication charts/grids or addition charts/grids while writing the test.

3. In the description of 3-D objects, there seems to be some discrepancy between the numbers of faces, edges and vertices for these objects. What should I be teaching my students?

The information on the chart below lists the number of faces, edges and vertices for the following 3-D objects:

Solid Figure	Faces	Edges	Vertex/ Vertices
Sphere	0	0	0
Cube	6	12	8
Pyramid (square)	5	8	5
Cone	1 (face is a circle)	1	1
Cylinder	2 (faces are circles)	2	0
Prism (rectangular)	6	12	8

4. The program of studies states that my students should understand multiplication up to 5 × 5. What does that mean?

By the end of grade three, students should be familiar with strategies that enable them to mentally determine products up to and including 5 × 5. The goal is for students to become increasingly efficient with these strategies in order to calculate the multiplication facts accurately.

Students should be using meaningful strategies to calculate the facts found on the following multiplication grid:

×	0	1	2	3	4	5
0	0	0	0	0	0	0
1	0	1	2	3	4	5
2	0	2	4	6	8	10
3	0	3	6	9	12	15
4	0	4	8	12	16	20
5	0	5	10	15	20	25

5. When will previous PATs, which are based on the 2007 Program of Studies, be released?

In June 2011, for the first time all grade three students in Alberta will write the PAT based on the *2007 Program of Studies*. Because this is a new test, the questions must be kept secure in order to ensure their validity. Actual multiple-choice questions from the test will not be released until 2012.

However, *A Guide for Teachers* (this document) will be updated each fall to inform and support teachers as they plan for the PAT.

Appendices

Appendix I:
Grade 3 Mathematics
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Sample Questions

Purpose:

These questions represent one way that students' understanding of an outcome or group of outcomes can be assessed. The information accompanying each question will include:

- the outcome(s) being assessed
- the level of complexity
- the mathematical processes a student may use when determining the solution
- ways students may choose to demonstrate their mathematical understanding
- an answer key

Format:

The sample questions in this document can be used to assess how students demonstrate their learning in a variety of ways, including explaining and justifying their solution to a problem.

For each set of questions, a brief explanation (context), picture, graph, diagram, and/or chart will be provided, followed by questions which are at different levels of difficulty and/or complexity. In order to facilitate formative assessment practices, the questions will not be presented in the multiple-choice format.

Teachers may choose to use the various levels of questions to support differentiation in the classroom and they are encouraged to use these questions in a manner that supports their instructional and assessment needs.

Test Preparation:

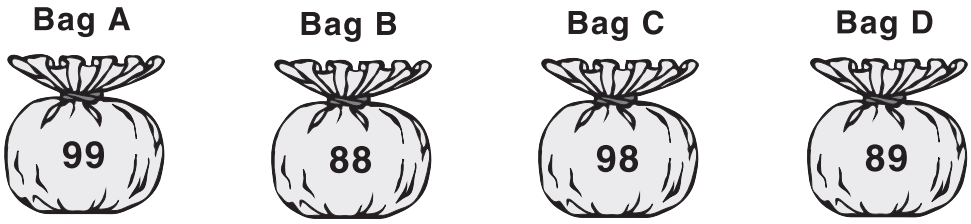
The **BEST** way to prepare students for the PAT is to ensure that students understand the outcomes in the program of studies. Numerous opportunities to discuss and solve a wide variety of mathematical problems are the most effective way to ensure that students are able to demonstrate their learning. "If students have already been given ways to solve a problem, it is not a problem, but practice. A true problem requires students to use prior learnings in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement." (p. 8, *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators*).

NOTE: Grade three is the first year that students are expected to write a test with multiple-choice questions. Teachers who believe that their students may benefit from seeing the basic format of the test can access released PATs at:
education.alberta.ca/admin/testing/achievement/answerkeys.aspx

Please note that these released tests are based on the 1997 Program of Studies and should **only** be used to familiarize students with the multiple-choice format of the PAT.

Question Set One: Bags of Marbles

Marnie has four bags of marbles. Each bag is filled with a different number of marbles.



1. Marnie combines the marbles in Bag A and Bag C and puts them in a box. How many marbles does Marnie have in the box?

Outcome(s)	Level of Complexity	Mathematical Processes
N. 8 (Also N.4 and N.9)	Low	C, ME, PS, R, V

Students may show their thinking by:

- using base-ten blocks to show how the two numbers can be combined
- using a personal strategy such as estimating and then verifying the sum using pictures or symbols

2. Which bag has the third-greatest number of marbles?

Outcome(s)	Level of Complexity	Mathematical Processes
N.3 (Also N.5 and N.3-Gr.2)	Moderate	C, CN, R, V

Students may show their thinking by:

- using an organized list, chart, or base-ten blocks

3. Marnie combines the marbles from Bag B and Bag C in a bowl. Then she gives half of these marbles to her brother. How many marbles does Marnie have left in the bowl?

Outcome(s)	Level of Complexity	Mathematical Processes
N. 9 (Also N.5)	High	C, CN, PS, R, V

Students may show their thinking by:

- adding the four numbers together using a personal strategy
- using their knowledge of place value to create the number 186 with base ten blocks or pictures
- separating the set of base-ten blocks (which will involve recombining) or pictures into two equal groups to show how many marbles are left

Answer Key:

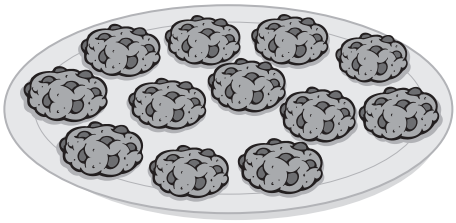
1. 197 marbles in bags A and C

2. Bag D

3. 93 marbles are left

Question Set Two: Cookies

Some cookies are on a plate.



1. If two children share the cookies on the plate equally, then how many cookies does each child have?

Outcome(s)	Level of Complexity	Mathematical Processes
N. 12	Low	C, CN, PS, R

Students may show their thinking by:

- modeling equal sharing using concrete or visual representations
- recording the sharing process symbolically using an equation

2. The twelve cookies on the plate can be put into different arrays. Create all the arrays that can be made with the cookies and write the matching multiplication expression for each array.

Outcome(s)	Level of Complexity	Mathematical Processes
N. 11	Moderate	C, CN, PS, R, V

Students may show their thinking by:

- drawing each array and writing the corresponding multiplication expression
- creating each array with counters and recording the corresponding multiplication equation

3. All twelve cookies on the plate are eaten by four children.

- **Ann eats two cookies**
- **Joe eats more cookies than Ann**
- **Lee eats more cookies than Joe**
- **Ray eats fewer cookies than Joe**

How many cookies does each child eat?

Ann eats _____ cookies. **Lee eats _____ cookies**

Joe eats _____ cookies. **Ray eats _____ cookies**

Outcome(s)	Level of Complexity	Mathematical Processes
N. 9 (Also N.10)	High	C, CN, PS, R, V

Students may show their thinking by:

- making an organized list or chart
- modeling/acting out the problem
- using counters to represent the cookies each child eats

Answer Key:

1. **6 cookies**

2. **Arrays:**

   1 x 12 = 12 and/or 12 x 1 = 12 Example array: • • • • • • • • • • • •

   2 x 6 = 12 and/or 6 x 2 = 12 Example array:
   • • • • • •
   • • • • • •

   3 x 4 = 12 and/or 4 x 3 = 12 Example array:
   • • • •
   • • • •
   • • • •

3. **Ann eats 2 cookies, Joe eats 4 cookies, Lee eats 5 cookies, Ray eats 1 cookie**
   OR
   Ann eats 2 cookies, Joe eats 3 cookies, Lee eats 5 cookies, Ray eats 2 cookies
   OR
   Ann eats 2 cookies, Joe eats 3 cookies, Lee eats 6 cookies, Ray eats 1 cookie

Question Set Three: Skip Counting

1. Jen is skip-counting forward by 100. She begins her counting pattern at the number 375. What numbers complete Jen's skip counting pattern?

375, _____ , _____ , _____ , _____

Outcome(s)	Level of Complexity	Mathematical Processes
N. 1 (Also PR.1)	Low	C, CN, ME

Students may show their thinking by:

- constructing the numbers using base-ten blocks
- using coins (loonies and quarters)

2. Cal's teacher asks him to complete the following number pattern chart.

14	**24**	**34**	**44**	**A**
4	**8**	**12**	**16**	**B**

The number that Cal puts in Box A is _____ .

The number that Cal puts in Box B is _____ .

Outcome(s)	Level of Complexity	Mathematical Processes
N. 1 (Also PR.1)	Moderate	C, CN, ME

Students may show their thinking by:

- identifying the skip-counting pattern in each row
  (top row: count by 10s; bottom row: count by 4s)
- use manipulative materials (counters, base-ten blocks, coins—dimes and pennies) to show how each number increases

3. Sue finds 3 separate number patterns on a hundreds chart. Each pattern decreases by a DIFFERENT amount.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Use numbers, words, and/or pictures to describe the 3 DIFFERENT decreasing patterns that Sue finds.

Pattern 1:

Pattern 2:

Pattern 3:

Outcome(s)	Level of Complexity	Mathematical Processes
N. 1 (also PR. 2)	High	C, CN, ME, PS, R

Students may show their thinking by:

- shading in the patterns on the hundreds chart, then writing the numbers in each one
- stating the skip-counting rule and then listing the numbers for each pattern
- describing each pattern in words

Answer Key:

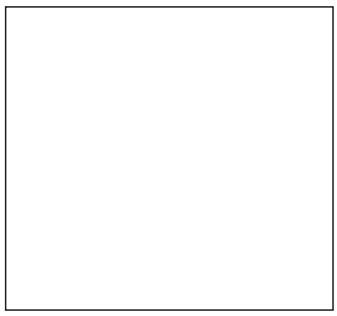
1. **<u>375</u>, 475, 575, 675, 775**

2. **Box A: 54**
   Box B: 20

3. **Answers will vary but all patterns given must show consistently decreasing amounts and each of the three patterns must be decreasing by a different amount (e.g., one pattern decreases by 10s, one pattern decreases by 3s, and one pattern decreases by 2s).**

Question Set Four: Fractions

1. James and Eva divide a piece of paper into four equal parts. James colours $\frac{1}{4}$ of the paper and Eva colours $\frac{3}{4}$ of the paper. How many parts of the paper does each child colour?



Outcome(s)	Level of Complexity	Mathematical Processes
N. 13	Low	C, CN, ME, R, V

Students may show their thinking by:

- dividing the paper into four parts, labeling the pieces and counting the pieces coloured by each child
- using fraction tiles or blocks to create the piece of paper and then counting the pieces each child colours
- taking a piece of paper, folding it into four equal parts, and then cutting out and counting the pieces

2. Eva's mom buys 3 pizzas to serve at a party. Each pizza is sliced into six equal pieces.

After the party, Eva's mom sees that half of the ham pizza was eaten, $\frac{2}{6}$ of the mushroom pizza was eaten, and $\frac{5}{6}$ of the cheese pizza was eaten. Shade in the number of pieces that were eaten from each pizza.

Ham Pizza

Mushroom Pizza

Cheese Pizza

Which kind of pizza was the most popular?

Which kind of pizza was the least popular?

Outcome(s)	Level of Complexity	Mathematical Processes
N. 13	Moderate	C, CN, ME, V

Students may show their thinking by:

- constructing the pizzas using fraction tiles
- tracing the shapes and cutting out the number of pieces eaten from each one

3. Julia played at the park for $\frac{9}{12}$ of an hour. Marek played at the park for $\frac{11}{12}$ of an hour. Who spent more time playing at the park? Use numbers, pictures and/or words to show how you know.

Outcome(s)	Level of Complexity	Mathematical Processes
N. 13 (Also SS. 1)	High	C, CN, ME, PS, R, V

Students may show their thinking by:

- drawing two shapes of the same size, dividing them into 12 equal parts and shading in the parts representing the amount of time played by each person
- using blocks to construct 2 shapes (12 blocks in each shape) and using the blocks to demonstrate which fraction is larger
- explaining how the numerators of two fractions with the same denominator can be compared in order to determine which fraction is larger.

Answer Key:

1. **James colours 1 part of the paper, Eva colours 3 parts of the piece of paper.**

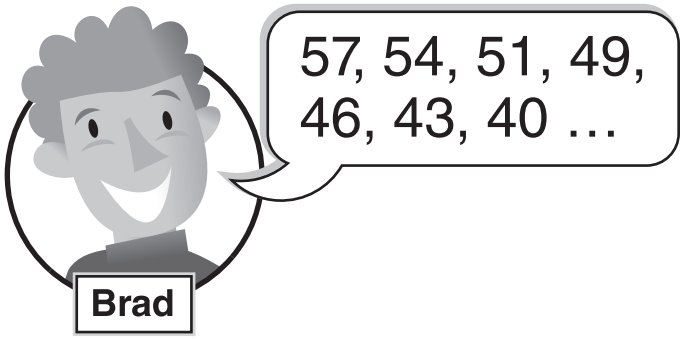
2. **Ham pizza: 3 pieces shaded**
   Mushroom pizza: 2 pieces shaded
   Cheese pizza: 5 pieces shaded

   Alternate questions:
   Cheese pizza was the most popular.
   Mushroom pizza was the least popular.

3. **Marek**

Question Set Five: Patterns

1. Starting with 57, Brad counts backwards by 3. He says



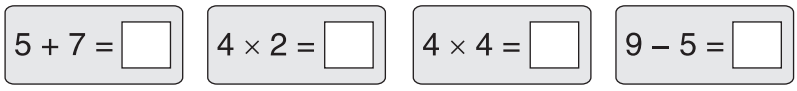
The first mistake that Brad makes in his counting pattern is when he says the number _____.

Outcome(s)	Level of Complexity	Mathematical Processes
PR. 2 (Also N.1 and N.3)	Low	C, CN, R, V

Students may show their thinking by:

- skip-counting backwards by 3 and writing down the numbers
- repeated subtraction of the number three, beginning with 57

2. Jane solves the equations on her number fact cards.



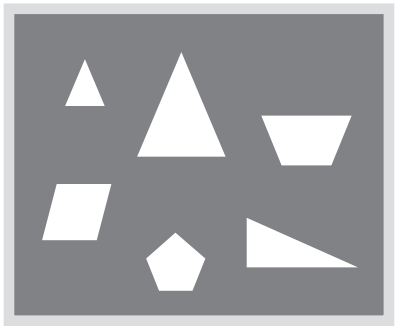
She discovers that the answers on her number fact cards can be arranged to form a pattern. What pattern can Jane make with the answers on her number fact cards?

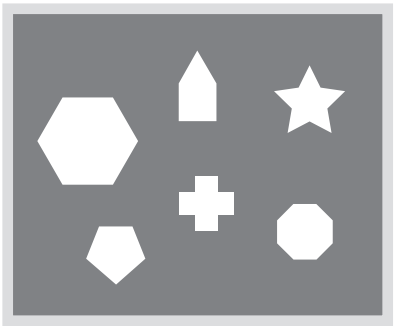
Outcome(s)	Level of Complexity	Mathematical Processes
PR. 1 (Also N.10 and N.11)	Moderate	C, CN, ME, PS, R, V

Students may show their thinking by:

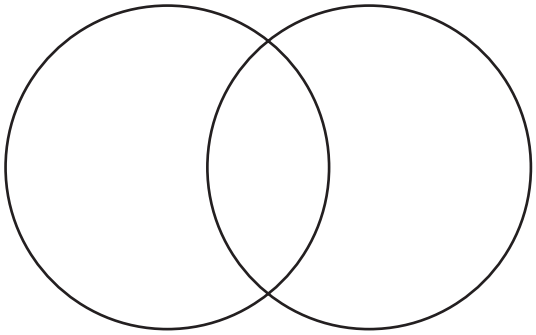
- using a mental mathematics strategy to determine the solution to the basic facts
- recording the answers on cards and arranging the cards to show and explain the pattern

3. Using a sorting rule, Ali puts the following shapes into two groups.





He sees that he can make a Venn diagram using these shapes and his sorting rule. Complete Ali's Venn diagram.



Outcome(s)	Level of Complexity	Mathematical Processes
PR. 3 (Also SS.7)	High	C, CN, PS, R, V

Students may show their thinking by:

- using concrete shapes and sorting them into groups
- looking for common attributes and stating a sorting rule

Answer Key:

1. **Brad makes the error when he says the number 49.**

2. **Basic Fact Card Answers: 5 + 7 = 12, 4 × 2 = 8, 4 × 4 = 16, and 9 – 5 = 4**
   The solutions can be arranged in an increasing pattern (skip counting by 4): 4, 8, 12, 16 or a decreasing pattern: 16, 12, 8, 4. Students may be able to demonstrate other patterns with the numbers as well but they should be able to explain their pattern.

3. **Sorting Rule – Sorting Mat A has shapes with 5 sides or less; Sorting Mat B has shapes with 5 sides or more.**
   The centre of the Venn diagram should contain the 5-sided shapes because both groups have this shape in common.

Question Set Six: Equations

1. Jake groups some stars together to represent the equation 17 = 8 + ? .

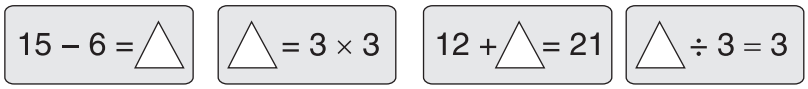
The number of stars that are missing from Jake's equation is _____.

Outcome(s)	Level of Complexity	Mathematical Processes
PR. 4 (Also N. 10)	Low	C, CN, PS, R, V

Students may show their thinking by:

- creating the equation using counters
- drawing stars (shapes) in the unknown number circle

2. Miles studies the following equations. He discovers that he can use the same number to solve all of them.



What number does Miles use to solve the equations?

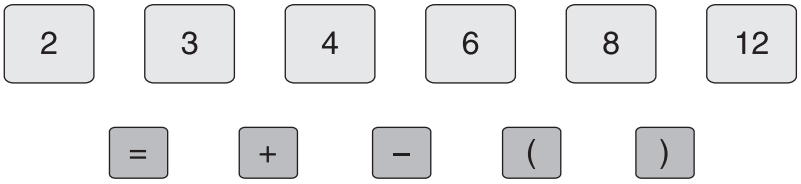
Outcome(s)	Level of Complexity	Mathematical Processes
PR. 4 (Also N.10, N.11, and N. 12)	Moderate	C, CN, ME, PS, R, V

Students may show their thinking by:

- using a mental mathematics strategy to determine the solution to the basic facts
- using concrete materials to represent the equations
- drawing pictures to solve the equations

3. The Equation Making Game

- **Create at least 10 equations by using the numbers and symbols.**
- **You do not have to use all of the numbers and symbols in one equation.**
- **You may use the numbers and/or symbols more than once.**



Outcome(s)	Level of Complexity	Mathematical Processes
PR. 4 (Also N.10, N.11, and N. 12)	High	C, CN, ME, PS, R, V

Students may show their thinking by:

- using an organized/systematic list to ensure they find all possible equations
- building each equation using manipulative materials
- expressing the equations pictorially as well as symbolically

Answer Key:

1. 9 stars.

2. Missing number: 9

3. Answers may vary. Students can create a variety of equations such as:

2 + 2 = 4 or 4 = 2 + 2
3 + 3 = 6 or 6 = 3 + 3
4 + 4 = 8 or 8 = 4 + 4
6 + 6 = 12 or 12 = 6 + 6
2 + 6 = 8 or 8 = 2 + 6
2 + 4 = 6 or 6 = 2 + 4
4 + 8 = 12 or 12 = 4 + 8

2 + 6 = 6 + 2
8 + 4 = 4 + 8
(2 + 3) + 4 = 2 + (3 + 4)
6 + 8 + 2 + 3 = (8 + 2) + 6 + 3
2 + 2 = 12 – 8
12 – 6 = 2 + 4

2 + 2 + 2 = 6
2 + 3 + 3 = 8
4 + 4 + 4 = 12
6 + 4 + 2 = 12
8 + 2 + 2 = 12

12 – 8 = 4
12 – 6 = 6
4 – 2 = 2

12 – 6 = 8 – 2
8 – 6 = 4 – 2

6 – 4 = 2
4 = 6 – 2
6 = 8 – 2

(Note: Students may use the commutative property of addition and/or associative property of addition—Grade 2 N. 9—when creating their addition equations.)

Question Set Seven: Passage of Time

1. Rachel is going to play with Simone for 1 hour. They will play in the swimming pool for 50 minutes and then eat some snacks.

How much time does it take for Rachel and Simone to eat some snacks?

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 2 (Also N. 9)	Low	C, CN, PS, R, V

Students may show their thinking by:

- using concrete materials (such as a clock, base-ten materials, nickels or dimes) to represent time in 10 minute segments
- writing an equation (60 – 50 = 10)

2. Max has made his bed every day from the beginning of March through March 22. Each day that Max makes his bed, he crosses the date off on the calendar.

If Max continues to make his bed every day after March 22, then how many more days will he have to make his bed until the end of March?

MARCH						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

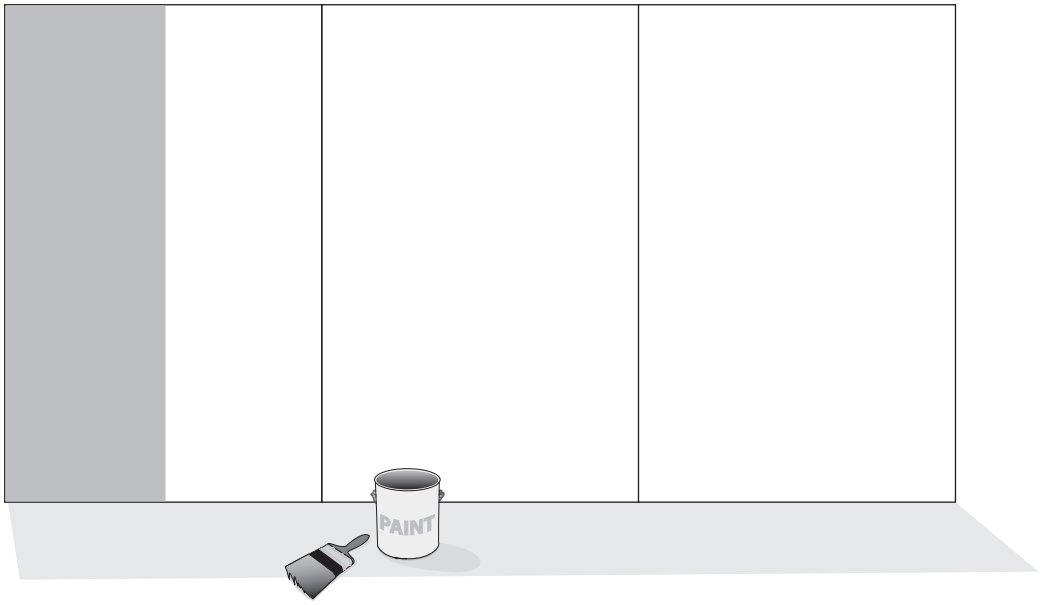
Outcome(s)	Level of Complexity	Mathematical Processes
SS. 1 (Also N. 3 and N. 9)	Moderate	C, CN, PS, R, V

Students may show their thinking by:

- crossing off dates on the calendar in order to count the number of days left
- determining and writing an equation that can be used to solve the problem (e.g., 31 – 22 = 9)

3. Jack is painting three boards that are the same size. It takes Jack 30 minutes to paint $\frac{1}{2}$ of a board.

If Jack paints each board at the same speed, how many hours will it take him to paint all three boards?



Outcome(s)	Level of Complexity	Mathematical Processes
SS. 1 (Also SS. 2, N. 9 and N. 13)	High	C, CN, PS, R, V

Students may show their thinking by:

- dividing each board in half, labelling it as taking 30 min, adding the times for all the boards together and calculating the number of hours in 180 minutes
- using concrete materials such as clocks, coins, base-ten blocks

Answer Key:

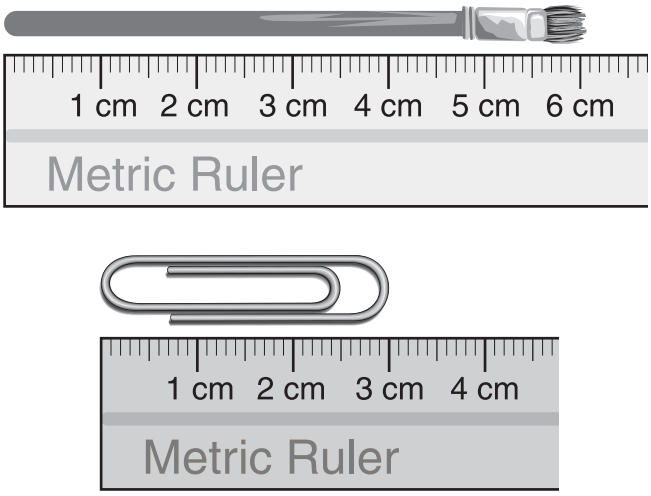
1. 10 minutes

2. 9 more days

3. 3 hours to paint all three boards

Question Set Eight: Measurement

1. Tim compares the length of a paperclip with the length of a mini-paintbrush.



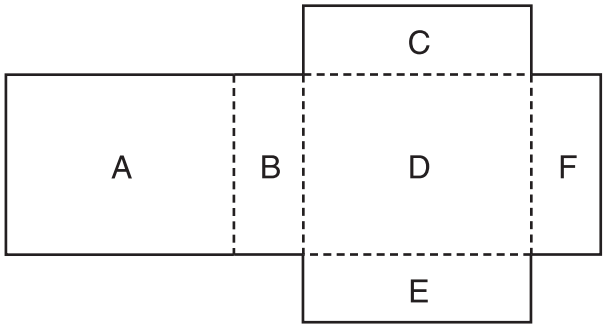
How many paperclips will be the same length as 2 mini-paintbrushes?

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 3 (Also N. 9)	Low	C, CN, PS, R, V

Students may show their thinking by:

- using concrete materials (such as a ruler, paperclips)
- drawing a picture and/or using symbols to represent their reasoning (e.g., 2 paperclips are the same length as 1 paintbrush so 4 paperclips must be the same length as 2 paintbrushes)

2. Rory writes some letters on the faces of a cardboard box that he has unfolded. He sees that some of the faces have the same perimeter.



Which faces have the same perimeter?

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 5 (Also SS. 6)	Moderate	C, CN, ME, PS, R, V

Students may show their thinking by:

- using a ruler to measure the sides of each face, then identifying the faces that are the same
- tracing the shape and matching their tracing with the original to see which faces have the same perimeter

3. Construct three DIFFERENT shapes that each have a perimeter of 20 centimetres. Use 1 cm × 1 cm grid paper. On all three shapes, write the length of each side.

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 5	High	C, ME, PS, R, V

Students may show their thinking by:

- drawing the three different shapes on the grid paper and labeling the sides with the correct length

Increasing the learning:

- students create a picture using the shapes that they have created—the shapes may need to be modified but will still need to meet the criteria of 20 cm perimeters.

Answer Key:

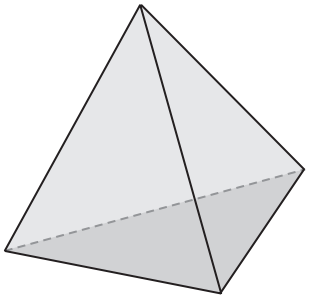
1. 4 paper clips

2. Faces with the same perimeters: A and D, C and E, B and F

3. Answers will vary. All three shapes should be different; sides should be correctly labelled with their lengths in cm.

Question Set Nine: 3-D Objects/2-D Shapes

1. Ben looks at the triangular pyramid shown below.



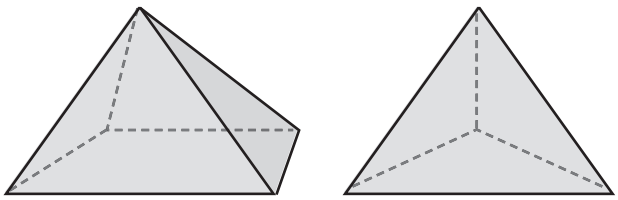
Ben sees that the triangular pyramid has _____ faces, _____ vertices, and _____ edges.

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 6	Low	C, CN, R, V

Students may show their thinking by:

- using a model of a triangular pyramid and counting the faces, vertices and edges on the model
- creating a skeleton of a triangular pyramid that matches the picture

2. Parker looks at the two 3-D objects shown below.



The two 3-D objects are alike because they _____ .

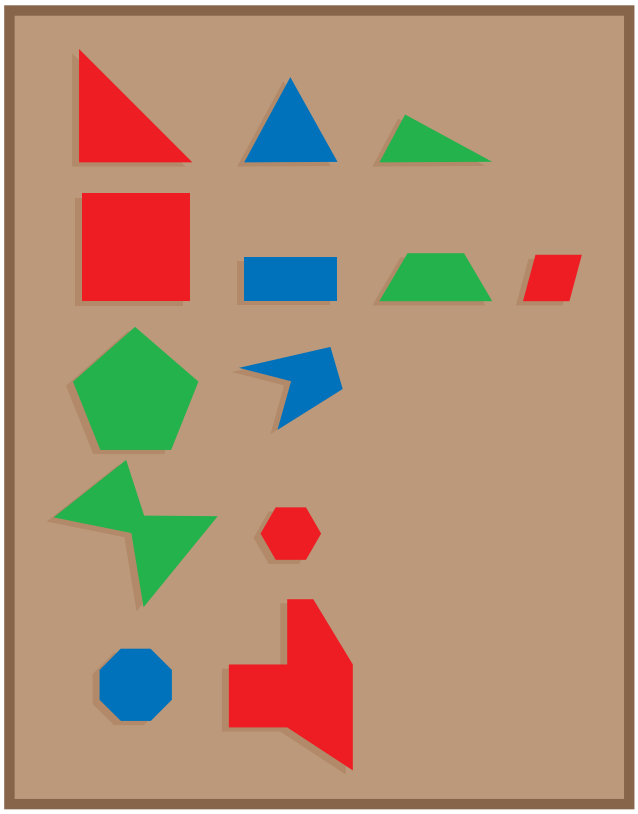
The two 3-D objects are different because they _____ .

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 6 (Also SS. 7)	Moderate	C, CN, PS, R, V

Students may show their thinking by:

- using models of a rectangular-based pyramid and triangular-based pyramid to show similarities and differences
- creating skeletons of the two shapes and using them to describe the similarities and differences

3. Sort the polygons shown below in as many different ways as possible.



What are your different sorting rules? _____

Outcome(s)	Level of Complexity	Mathematical Processes
SS. 7 (Also PR. 3)	High	C, CN, PS, R, V

Students may show their thinking by:

- using models of the polygons when creating the four groups
- tracing the polygon shapes, cutting them out and sorting them

Increasing the learning:

- students create a Venn diagram using the polygons in the question

Answer Key:

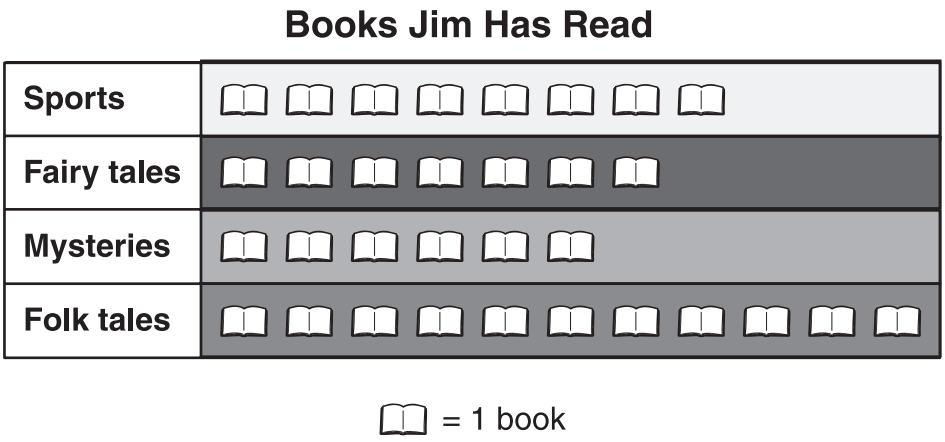
1. **4 faces, 4 vertices, and 6 edges**

2. **Alike:** **Both shapes are pyramids; they both have at least 3 triangular faces and at least 3 vertices; the edges on both shapes are straight.**
   Different: **One shape is a pyramid with rectangular face and 4 triangular faces, 5 vertices, and 8 edges; the other shape is a pyramid with 3 triangular faces, 4 vertices, and 6 edges.**

3. **Answers will vary. Some sorting rules could be:**
   a. **size**
   b. **colour**
   c. **number of sides**
   d. **regular and irregular polygons**

Question Set 10: Statistics (Graphs)

1. Jim makes a pictograph of the books he has read this year.



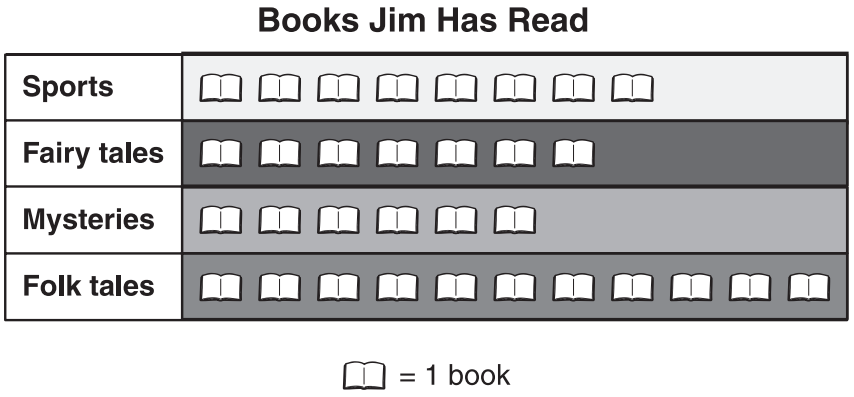
How many more folk tale books than mystery books did Jim read?

Outcome(s)	Level of Complexity	Mathematical Processes
SP. 1 (Also N. 9)	Low	C, CN, PS, V

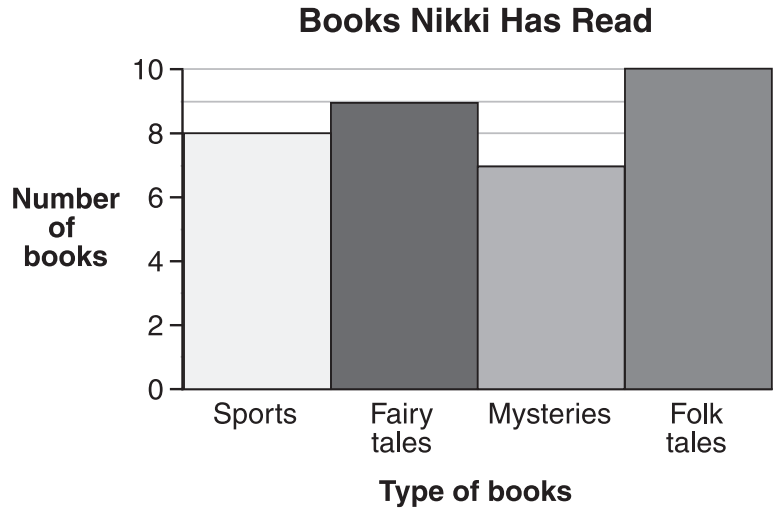
Students may show their thinking by:

- making a model of the pictograph using concrete materials
- using counters when calculating the difference

2. Jim makes a pictograph of the books he has read this year.



Nikki makes a bar graph of the books she has read this year.



a. How many fairy tale books did Jim and Nikki read in TOTAL? _____

b. The type of book that Jim and Nikki both read the SAME number of is _____ .

c. In all, how many FEWER books did Jim read than Nikki? _____

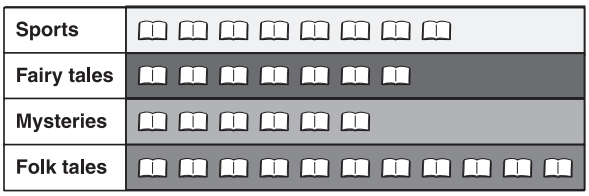
Outcome(s)	Level of Complexity	Mathematical Processes
SP. 2 (Also SP. 1, N. 9, and Gr. 2 SP. 2)	Moderate Note: Questions a. and b. are classified as moderate in complexity, question c. is classified as high in complexity.	C, CN, PS, R, V

Students may show their thinking by:

- making a model of the pictograph using concrete materials
- using counters when calculating the sums and differences
- using a ruler when interpreting the bar graph
- recording their interpretations of the graphs symbolically (i.e., writing the numbers above or beside each column that is counted)

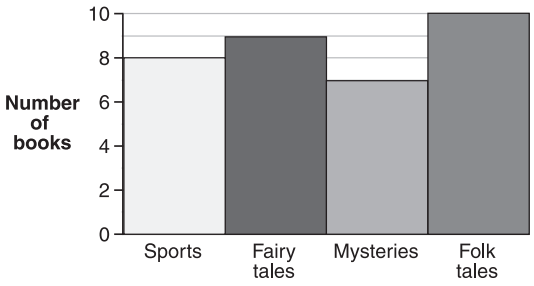
3. Using the information from the two graphs shown below, construct and label a bar graph that represents the combined number of books read by Jim and Nikki.

Books Jim Has Read



📖 = 1 book

Books Nikki Has Read



Total Number of Books Jim and Nikki Have Read

Outcome(s)	Level of Complexity	Mathematical Processes
SP. 2 (Also SP. 1, N. 9, and Gr. 2 SP. 2)	High	C, CN, PS, R, V

Students may show their thinking by:

- determining the total number of each type of book using concrete materials
- drawing a bar graph and accurately labeling the axes
- drawing the columns in the graph to represent the total number of each type of book read

Increasing the learning:

- Students formulate questions about the data on their newly constructed bar graph

Answer Key:

1. 5 more folk tale books than mystery books

2. a. 16 fairy tale books

b. Jim and Nikki read the same number of sports books

c. Jim read 32 books, Nikki read 34 books. Jim read 2 fewer books than Nikki.

3. Answers will vary somewhat, but the graph should have the following components:

a. One axis of the graph should have a scale that goes to at least 22 and should have a label indicating that it represents the "Number of Books"

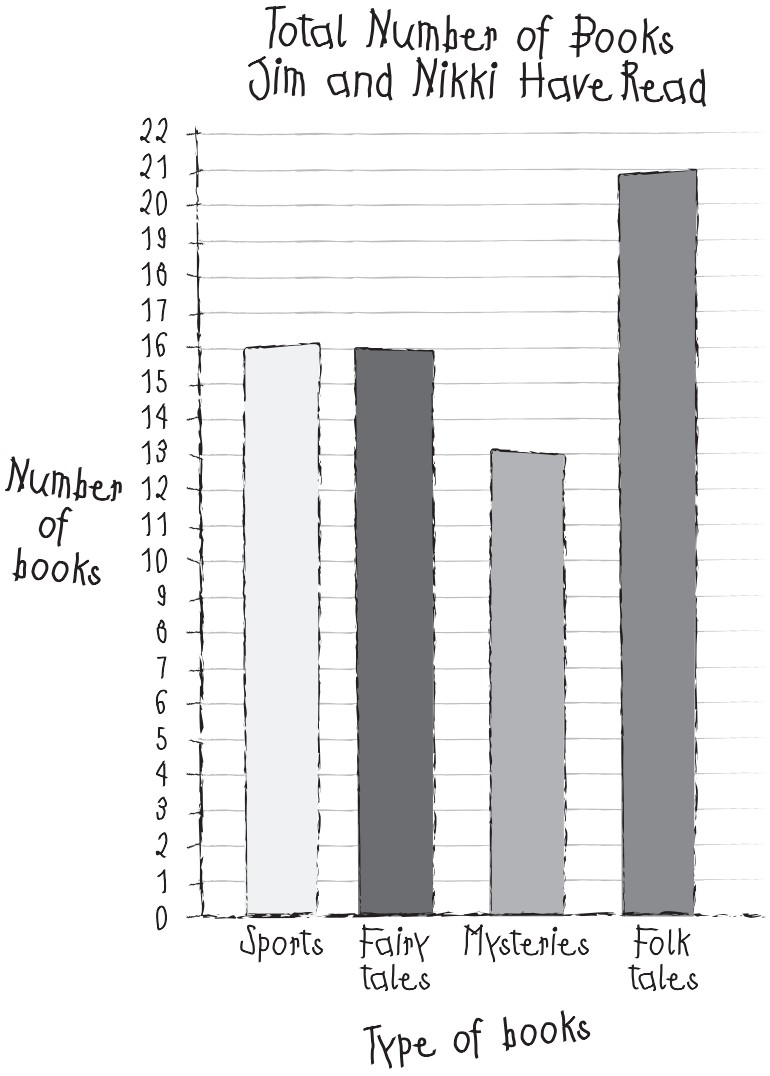
b. The other axis of the graph should have a label indicating "Type of book." This axis should have the following columns:
– "Sports", which represents 16 books
– "Fairy tales", which represents 16 books
– "Mysteries", which represents 13 books
– "Folk tales", which represents 21 books

c. The columns should have a small space between each other.

(continued on next page)

Answer Key *continued*:

Possible graph:



Appendix II:
Grade 3 Mathematics
Constructed-Response Questions
for Classroom Use

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1. ***Constructed-Response Questions***
   - Question One: Bridge Pillars
   - Question Two: Mass of Seeds
2. ***Scoring Guides***
3. ***Exemplars and Rationales***

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Introduction

Purpose of the Constructed-Response Questions:

These questions were developed to support teachers in the implementation of the *2007 Mathematics Program of Studies*. A major focus of the revised curriculum is the expectation that students will explain, describe and/or justify their mathematical thinking. Constructed-response questions provide students with the opportunity to demonstrate their mathematical understanding.

How to Use the Constructed-Response Questions:

Teachers are encouraged to use these questions in a manner that supports their instructional and assessment needs. Some suggestions for using the questions include using them as:

1. one type of summative assessment
2. a pre-test and as a post-test
3. examples to support classroom instruction
4. resources for partner and group work
5. a formative assessment tool

The Scoring Guides and Exemplars in this document can be used:

1. to assess student responses to the questions
2. as models for developing scoring guides and exemplars for similar types of questions used in the classroom
3. to support students in assessing their own work
4. to guide students in setting their own goals for improvement

How to Assess Students' Responses to the Constructed-Response Questions:

To provide each of your students' responses with the most accurate and impartial judgment possible, use the scoring criteria and the standards set by the Scoring Guides and Exemplars.

Using this document, teachers will be able to:

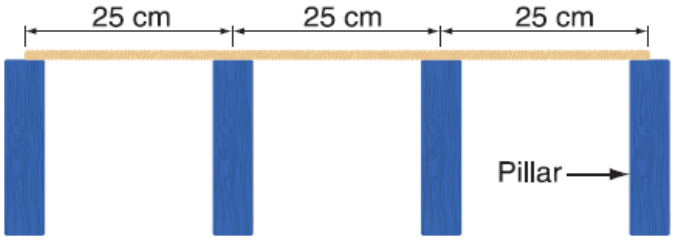
- review and internalize the scoring criteria and apply them to student responses
- apply the scoring criteria impartially, independently, and consistently to **all** responses
- score every response
  – fairly
  – according to the scoring criteria
  – in accordance with the standards reflected in the Scoring Guides and Exemplars

Note: The Scoring Guide was developed in consultation with Grade Three teachers from around Alberta. The Exemplars are samples of actual student work. They were selected and assessed by a team of Grade Three teachers.

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.

Raj uses _____ pillars.

Scoring Guide for Constructed-Response Question 1

To determine the number of pillars used along the length of a 150 cm bridge, students will demonstrate an understanding of concepts and mathematical processes from the:

Number Strand

SO 1.d. Say the number sequence 0 to 1000 forward and backward by 25, using starting points that are multiples of 25. [C, CN, ME]

SO 2 Represent and describe numbers to 1000, concretely, pictorially, and symbolically. [C, CN, V]

SO 9.b. Demonstrate an understanding of addition and subtraction of numbers with answers to 1000, concretely, pictorially and symbolically, by … solving problems in context that involve addition and subtraction of numbers. [C, CN, ME, PS, R, V]

Patterns and Relations

SO 1.b. Understanding and extending a numerical pattern. [C, CN, ME]

Space and Shape Strand

SO 3.d. Demonstrate an understanding of measuring length (cm, m) by measuring and recording length, width, and height. [C, CN, ME, PS, R,V]

3-Point Response:

The problem-solving process used to determine the number of pillars used along the length of a bridge shows a HIGH degree of effectiveness due to:
- a thorough understanding of the concepts
- a complete application of mathematical processes
- a correct answer with clearly recorded supporting evidence

2-Point Response:

The problem-solving process to determine the number of pillars used along the length of a bridge shows CONSIDERABLE effectiveness due to:
- an understanding of the concepts
- an application of mathematical processes that is nearly complete
- an appropriate answer with some supporting evidence; there may be minor errors and/or omissions in the application of procedures

1-Point Response:

The problem-solving process to determine the number of pillars used along the length of a bridge shows SOME effectiveness due to:
- partial understanding of the concepts
- an incomplete application of mathematical processes
- an incorrect answer or an answer with little or no supporting evidence

0-Point Response:

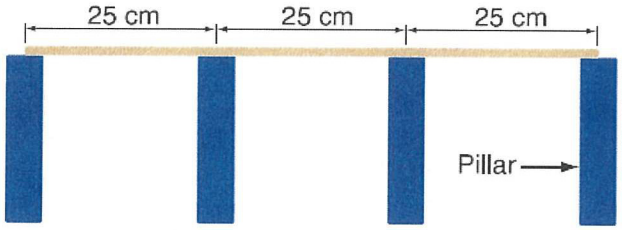
The problem-solving process to determine the number of pillars used along the length of a bridge shows LIMITED effectiveness due to:
- misunderstanding of the concepts
- an incorrect application of mathematical processes
- no answer OR an incorrect answer

Student Exemplar A
Score: 0

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

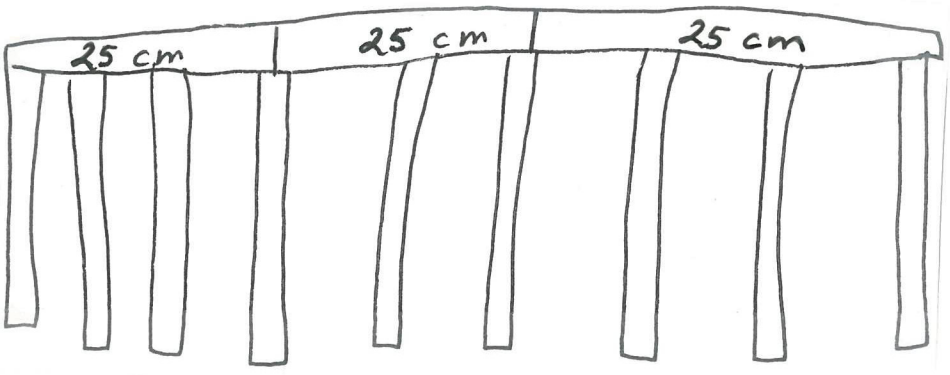
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



Raj uses 18 **pillars.**

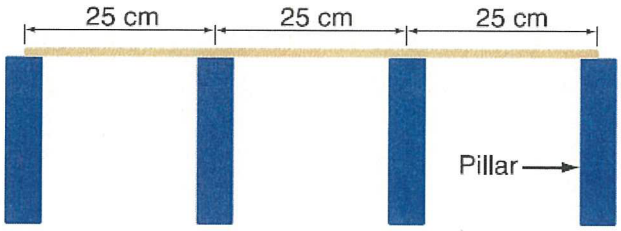
Rationale:
The student demonstrates a misunderstanding of the concepts; draws 9 pillars with no justification and then concludes that 18 pillars are used.

Student Exemplar B
Score: 0

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

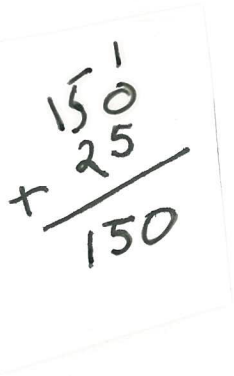
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



Raj uses 150 **pillars.**

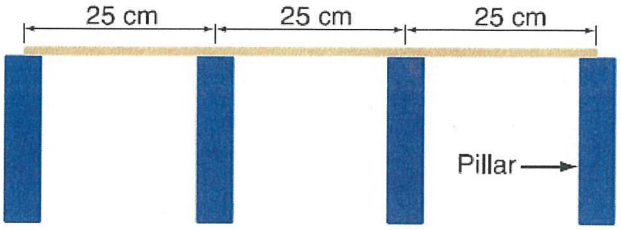
Rationale:
The student demonstrates a misunderstanding of the concepts; attempts to add 150 and 25, then states that 150 pillars are used.

Student Exemplar C
Score: 1

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

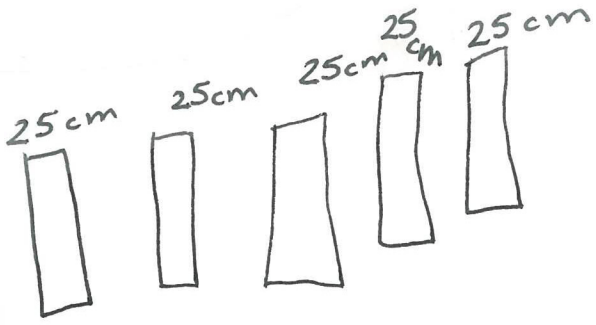
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



25 + 25 + 25 + 25 + 25 + 25 = 150

Raj uses _____ pillars.

Rationale:

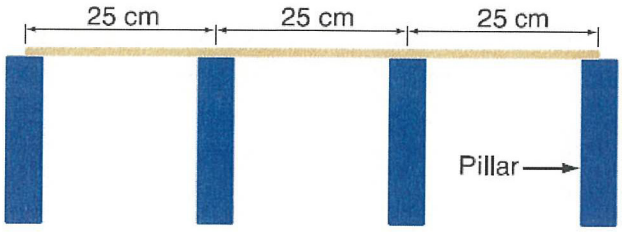
The student demonstrates partial understanding of the concepts; uses repeated addition of 25 to reach a total of 150 and draws 5 pillars. Student does not demonstrate a connection between 150 and the total number of pillars used.

Student Exemplar D
Score: 1

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

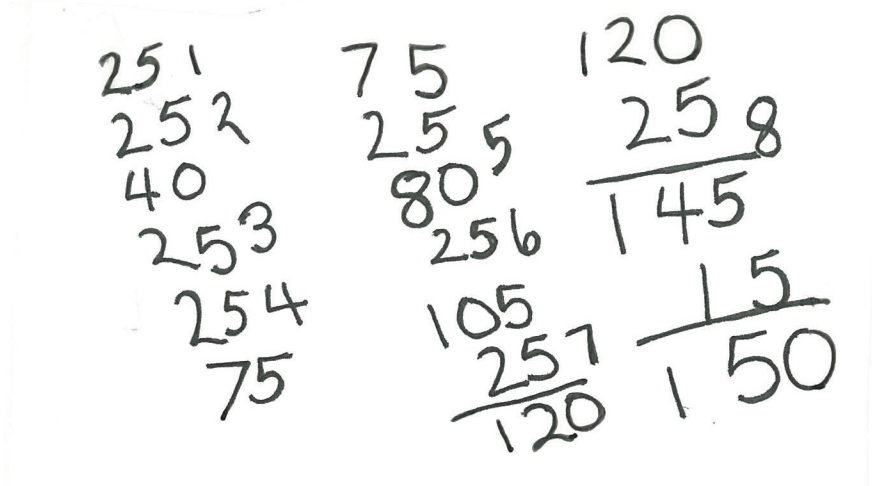
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



Raj uses 8 **pillars.**

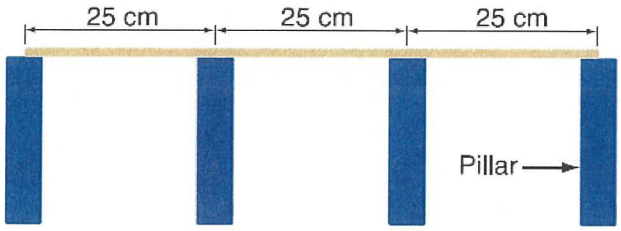
Rationale:
The student demonstrates partial understanding of the concepts; attempts to use repeated addition of 25 to reach a total of 150, although the solution process is not accurate. Student incorrectly concludes that 8 pillars are used.

Student Exemplar E
Score: 1

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.

He needs 7.

Raj uses 7 **pillars.**

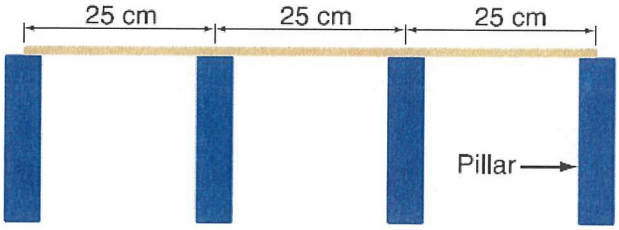
Rationale:
The student states the correct answer, but there is no supporting evidence provided.

Student Exemplar F
Score: 2

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.

25+25+25+25+25+25=150

So what I did was that I added 25 and kept on doing it when I got the number 150.

Raj uses 6 **pillars.**

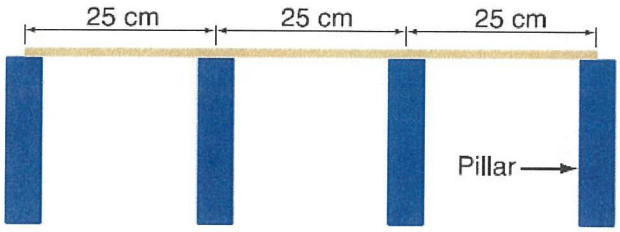
Rationale:
The student demonstrates considerable understanding of the concepts; records and explains repeated addition of 25 to find a total of 150; conclusion is off by 1 pillar.

Student Exemplar G
Score: 2

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

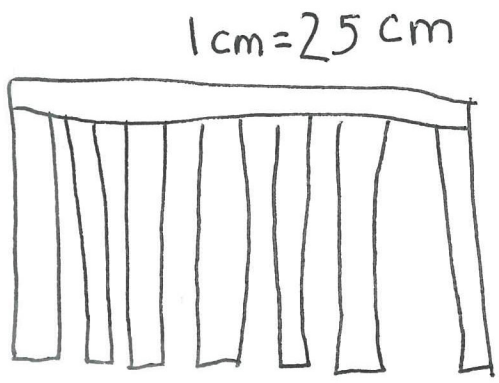
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



1 25 50
2 25 75
3 25
4 25 100
5 25 125
6 + 25 150
1 50

Raj uses 6 pillars.

Rationale:

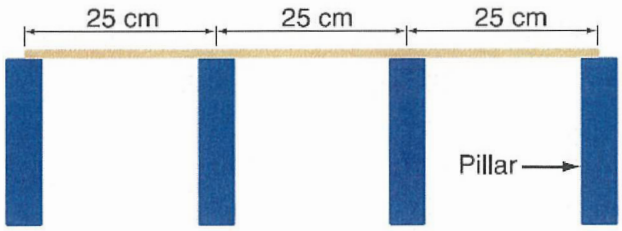
The student demonstrates considerable understanding of the concepts; records the repeated addition of 25 to find a total of 150; draws a diagram that shows the correct number of pillars but concludes that 6 pillars are used.

Student Exemplar H
Score: 3

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

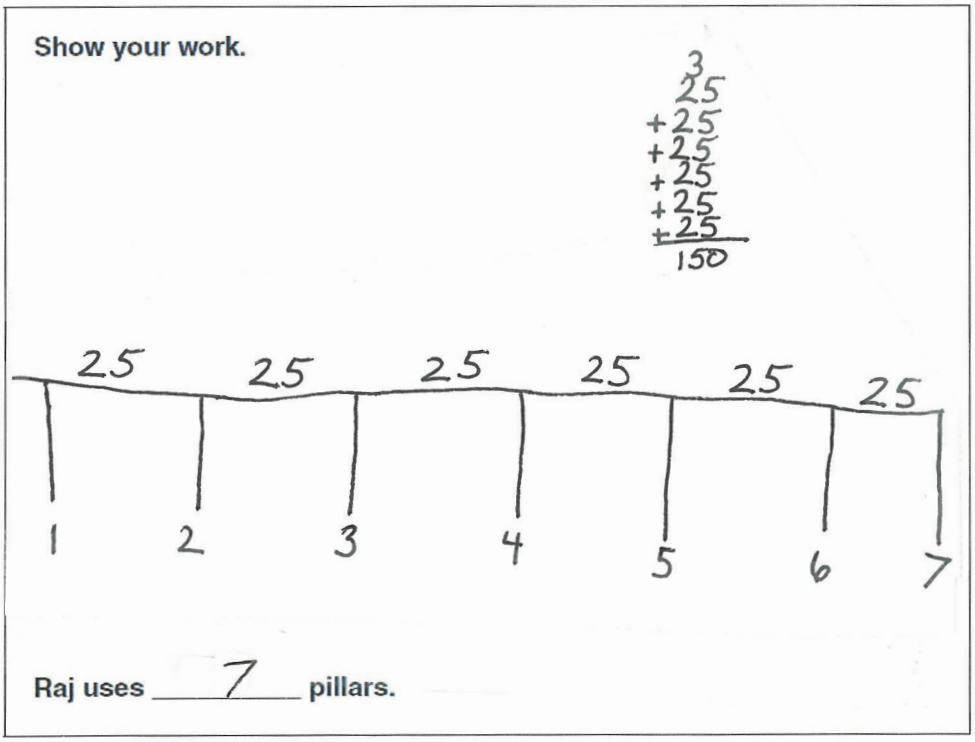
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



Raj uses 7 **pillars.**

Rationale:

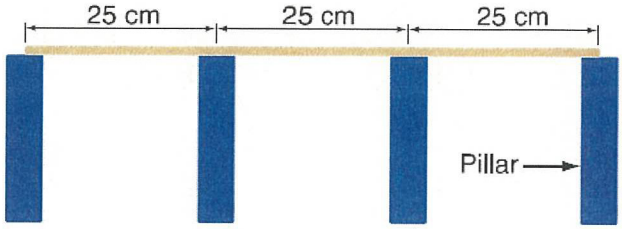
The student demonstrates a thorough understanding of the concepts; records repeated addition to find a total of 150; accurately draws and labels a diagram which shows the correct number of pillars used.

Student Exemplar I
Score: 3

Constructed-Response Question 1

Raj uses blocks to build a bridge. He puts a pillar every 25 cm along the entire length of the bridge.

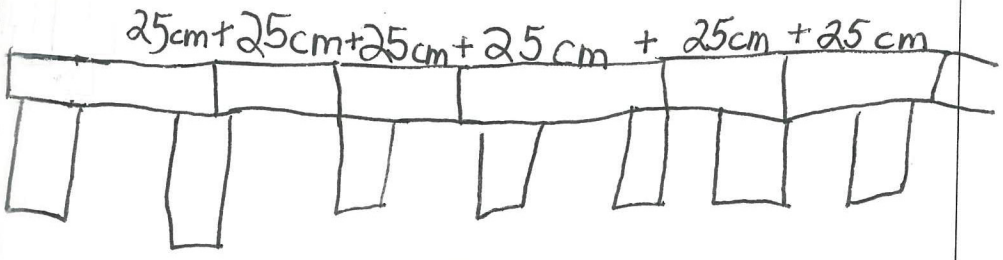
Part of Raj's Bridge



How many pillars in TOTAL does Raj use if he builds a bridge that is 150 cm long?

Answer the question using numbers, words, and/or pictures.

Show your work.



I just added all the 25 cms together and I got 150cm and 7 pillars.

Raj uses 7 **pillars.**

Rationale:

The student demonstrates a thorough understanding of the concepts; describes the repeated addition of 25 to find a total of 150; draws a diagram which shows the correct number of pillars used.

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

The mass of the sunflower seeds left in Tim's bag is _____ g.

Scoring Guide for Constructed-Response Question 2

To calculate the mass of sunflower seeds left in a bag without using a scale, students will demonstrate an understanding of concepts and mathematical processes from the:

Number Strand

SO 5. Illustrate, concretely and pictorially, the meaning of place value for numerals to 1000. [C, CN, R, V]

SO 9.b. Demonstrate an understanding of addition and subtraction of numbers with answers to 1000, concretely, pictorially and symbolically, by … solving problems in context that involve addition and subtraction of numbers. [C, CN, ME, PS, R, V]

Space and Shape Strand

SO 4.d. Demonstrate an understanding of measuring mass (g, kg) by measuring and recording mass. [C, CN, ME, PS, R, V]

3-Point Response:

The problem-solving process used to determine the mass of seeds left in the bag without using a scale shows a HIGH degree of effectiveness due to:

- a thorough understanding of the concepts
- a complete application of mathematical processes
- a correct answer with clearly recorded supporting evidence

2-Point Response:

The problem-solving process to determine the mass of seeds left in the bag without using a scale shows CONSIDERABLE effectiveness due to:

- an understanding of the concepts and mathematical processes
- an application of mathematical processes that is nearly complete
- an appropriate answer with some supporting evidence; there may be minor errors and/or omissions in the application of procedures

1-Point Response:

The problem-solving process to determine the mass of seeds left in the bag without using a scale shows SOME effectiveness due to:

- partial understanding of the concepts and mathematical processes
- an incomplete application of mathematical processes
- an incorrect answer or an answer with little or no supporting evidence

0-Point Response:

The problem-solving process to determine the mass of seeds left in the bag without using a scale shows LIMITED effectiveness due to:

- misunderstanding of the concepts and mathematical processes
- an incorrect application of mathematical processes
- no answer OR an incorrect answer

Student Exemplar A
Score: 0

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

148g − 141g = 7

148g − 29 = 119

The mass of the sunflower seeds left in Tim's bag is 119 **g.**

Rationale:
The student demonstrates a misunderstanding of concepts; it is unclear where some of the numbers used in the solution process were obtained. The answer is incorrect.

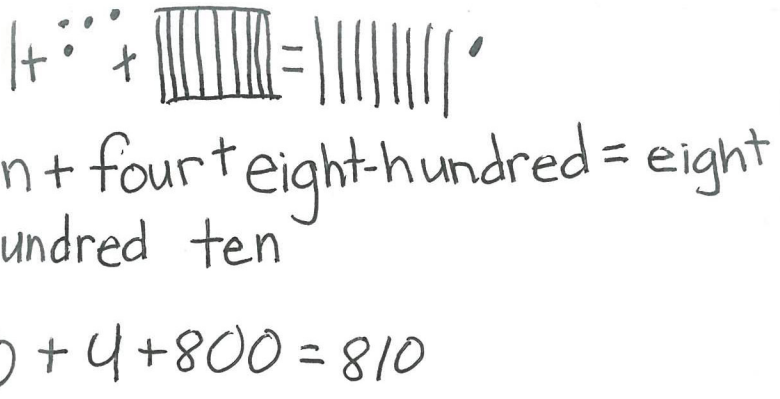
Student Exemplar B
Score: 0

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.



The mass of the sunflower seeds left in Tim's bag is 810 **g.**

Rationale:
The student demonstrates a misunderstanding of concepts; place value of numbers is incorrectly represented. The solution is a number greater than the original mass of seeds.

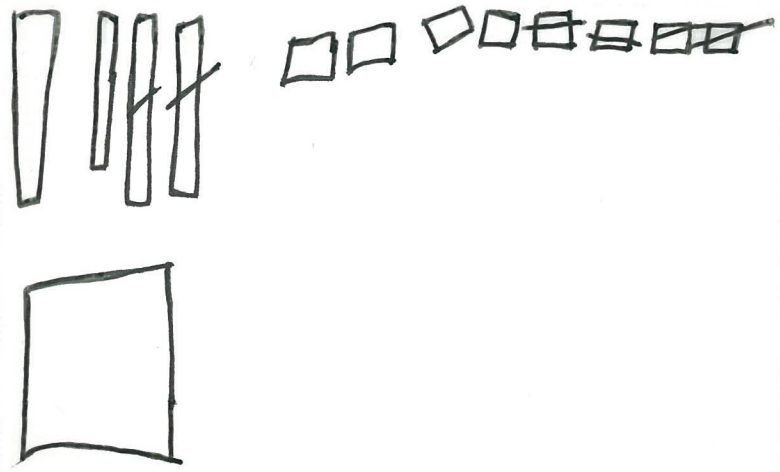
Student Exemplar C
Score: 1

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.



The mass of the sunflower seeds left in Tim's bag is 124 **g.**

Rationale:
The student demonstrates partial understanding of the concepts; draws base-ten blocks to represent 148, halves the groups of 10s and 1s but does not halve the hundreds flat. The base-ten blocks, which are not crossed out, are combined to determine a solution.

Student Exemplar D
Score: 1

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

half of 100 = 50

So that means its

98

50
+ 48
98

The mass of the sunflower seeds left in Tim's bag is 98 **g.**

Rationale:
The student demonstrates partial understanding of the concepts; indicates that 100 should be reduced by half but does not reduce the 48 by half. The student adds 50 to the 48 to obtain a solution.

Student Exemplar E
Score: 1

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

if he has 148
then he gives half to the birds it equals 74

The mass of the sunflower seeds left in Tim's bag is 74 **g.**

Rationale:
The student states the correct answer but gives little supporting evidence; the problem is restated and there is no indication of how the answer was determined.

Student Exemplar F
Score: 2

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

I cut the numbers in half and added 1 half of each together

The mass of the sunflower seeds left in Tim's bag is 74 **g.**

Rationale:
The student demonstrates considerable understanding of the concepts; a partial description of the solution process is given with some supporting evidence (numbers are halved and then added together).

Student Exemplar G
Score: 2

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

I split $\frac{100}{50}$, $\frac{40}{20}$, $\frac{8}{4}$

and 50 + 20 + 4 is 78

78

The mass of the sunflower seeds left in Tim's bag is _____ g.

Rationale:
The student demonstrates considerable understanding of the concepts; the number is described in terms of place value and each part of the number is reduced by half. There is an error in the addition process used to determine the answer.

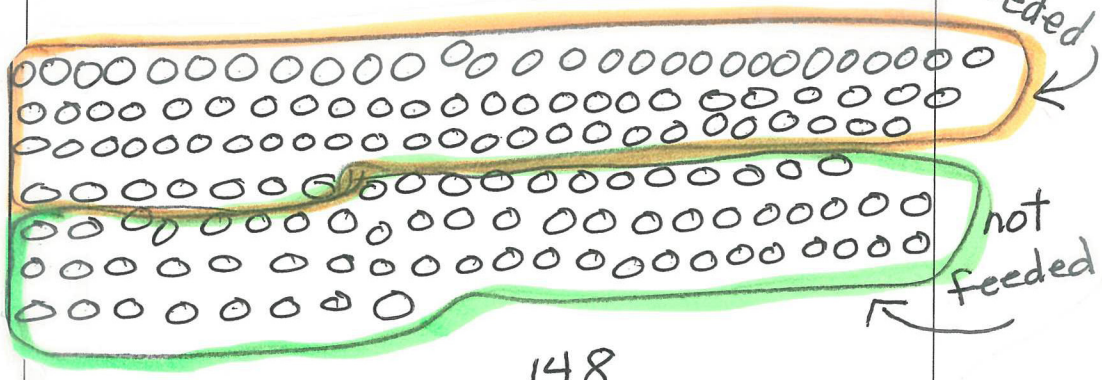
Student Exemplar H
Score: 2

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.



The mass of the sunflower seeds left in Tim's bag is 64 **g.**

Rationale:
The student demonstrates considerable understanding of the concepts; the number is represented by 148 circles and is divided into two groups. Due to a counting error, the groups are not equal; as a result the answer is incorrect but is supported by the evidence.

Student Exemplar I
Score: 3

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

hundreds	tens	ones
1	4	8

100 ÷ 2 = 50

40 ÷ 2 = 20

8 ÷ 2 = 4

50 + 20 + 4 = 74

The mass of the sunflower seeds left in Tim's bag is 74 g.

Rationale:
The student demonstrates a thorough understanding of the concepts; accurately represents the number using a place-value chart; indicates that each number is reduced by half; and then correctly adds the numbers together.

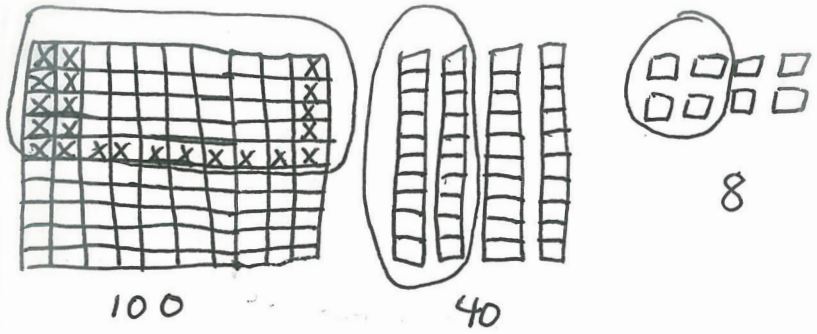
Student Exemplar J
Score: 3

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.



The mass of the sunflower seeds left in Tim's bag is 74 **g.**

Rationale:
The student demonstrates a thorough understanding of the concepts; accurately represents the number using base-ten blocks; indicates that each group of blocks is reduced by half; and then correctly adds the numbers together.

Student Exemplar K
Score: 3

Constructed-Response Question 2

Tim has a bag of sunflower seeds that has a mass of 148 g. He feeds half of the seeds to some birds. Tim calculates the mass of the sunflower seeds left in his bag without using a scale.

Use numbers, words, and/or pictures to show how Tim calculates the mass of the sunflower seeds left in his bag.

Show your work.

100 − half = 50 40 - half = 20

8 − half = 4

50 + 20 + 4 = 74

The mass of the sunflower seeds left in Tim's bag is 74 **g.**

Rationale:
The student demonstrates a thorough understanding of the concepts; represents the number demonstrating an understanding of place value; clearly shows how each number is halved; and then adds the numbers together.

Learner Assessment Contacts

Test administration, security, rules, and scheduling

Michele Samuel, Director
Examination Administration
Michele.Samuel@gov.ab.ca

Test accommodations

Pamela Klebanov, Coordinator
Special Cases and Accommodations
Pamela.Klebanov@gov.ab.ca
Test materials ship

Test materials shipping and receiving

Sylvia Lepine, Manager
Marking Centre
Sylvia.Lepine@gov.ab.ca

Field testing

Amanda Jackman, Coordinator
Field Testing
Amanda.V.Jackman@gov.ab.ca

Test design, development, scoring, and reporting

Ken Marcellus, Director
Achievement Testing Program
Ken.Marcellus@gov.ab.ca

Deanna Wiens
Examination Manager—Grade 3
English Language Arts and Mathematics
Achievement Testing Program
Deanna.Wiens@gov.ab.ca

Julia Lee-Schuppli
Examiner—Grade 3
English Language Arts and Mathematics
Achievement Testing Program
Julia.Lee-Schuppli@gov.ab.ca

Learner Assessment
Mailing Address:

Learner Assessment
Alberta Education
44 Capital Boulevard
10044 108 Street
Edmonton AB T5J 5E6

Telephone: (780) 427-0010
For a toll-free connection, dial 310-0000
Fax: (780) 422-4200
Alberta Education website: education.alberta.ca